What is claimed is:

1. A variable polarization plane rotator for rotating a polarization plane of linearly polarized light, comprising:

a phase plate that has an optical axis in the same direction as, or at a 90 degree angle relative to, a polarization direction of input light beam, and applies, to the light beam being transmitted, a 90 degree phase difference between a polarization component parallel to said optical axis and a polarization component perpendicular to said optical axis;

a phase difference variable element that has an optical axis at a ±45 degree angle relative to the optical axis of said phase plate, and applies, to the light beam being transmitted, a variable phase difference between the polarization component parallel to said optical axis and the polarization component perpendicular to said optical axis; and

a phase difference adjustment section that adjusts the variable phase difference of said phase difference variable element,

wherein said input light beam, after being transmitted through said phase difference variable element to be into an elliptically polarized light or a circularly polarized light, is transmitted through said phase plate, to be into a linearly polarized light, so that the polarization plane of said input light beam is rotated by an angle corresponding to the phase difference applied by said phase difference variable element.

2. A variable polarization plane rotator according to claim 1,

wherein said variable polarization plane rotator has a transmission type construction in which said input light beam output from an input side optical path is transmitted through said phase difference variable element and said phase plate in succession, to be input to an output side optical path.

A variable polarization plane rotator according to claim 1, further comprising a reflecting plate for reflecting light,

wherein said variable polarization plane rotator has a reflection type construction in which said input light beam output from an input side optical path is transmitted through said phase plate and said phase difference variable element in succession, to be reflected by said reflecting plate, and again transmitted through

said phase difference variable element and said phase plate in succession, to be input to an output side optical path.

4. A variable polarization plane rotator according to claim 1,

wherein said phase difference variable element is formed using a liquid crystal device.

5. A variable polarization plane rotator according to claim 1,

wherein said phase difference variable element is formed using a material having an electro-optical effect.

6. A variable polarization plane rotator according to claim 1,

wherein said phase plate is a 1/4 wavelength plate formed from a doubly refracting crystal.

7. A variable polarization plane rotator according to claim 1,

wherein instead of said phase plate, there is provided;

a second phase difference variable element that has an optical axis in the same direction as, or at a 90 degree angle relative to, the polarization direction of said input light beam, and applies, to the light beam being transmitted, a variable phase difference between the polarization component parallel to said optical axis and the polarization component perpendicular to said optical axis; and

a second phase difference adjustment section that adjusts such that the variable phase difference of said second phase difference variable element becomes 90 degrees depending on the wavelength of said input light beam.

8. A variable polarization plane rotator according to claim 7,

wherein said second phase difference variable element is formed using a liquid crystal device.

9. A variable polarization plane rotator according to claim 7,

wherein said second phase difference variable element is formed using a material having an electro-optical effect.

10. A variable optical attenuator using a variable polarization plane rotator of claim 1, comprising:

a first polarization separation element that carries out polarization separation of light output from an input side optical path to apply the separated lights to said variable polarization plane rotator; and

a second polarization separation element that carries out polarization separation of light output from said variable polarization plane rotator to input lights of predetermined polarization state into an output side optical path,

wherein an amount of light input to said output side optical path is made variable by adjusting a rotation angle of the polarization plane, at said variable polarization plane rotator, of the linearly polarized light which has been separated by said first polarization separation element.

11. A variable optical attenuator according to claim 10,

wherein a light output end face of said input side optical path is opposite to a light input end face of said output side optical path, and

said first polarization separation element, said transmission type variable polarization plane rotator of claim 2, and said second polarization separation element are arranged in succession between said light output end face and said light input end face.

12. A variable optical attenuator according to claim 10,

wherein a light output end face of said input side optical path and a light input end face of said output side optical path are arranged on the same side,

said first polarization separation element, and said reflection type variable polarization plane rotator of claim 3, are arranged in succession facing said light output end face and said light input end face, and

light transmitted through said first polarization separation element is reflected inside said variable polarization plane rotator to be returned to said first polarization separation element, so that said first polarization separation element also functions as said second polarization separation element.

13. An optical switch using a variable polarization plane rotator of claim 1, comprising:

a first polarization separation section that carries out polarization separation of light output from the input side optical path;

a polarization plane coincidence control section that makes a plurality of linearly polarized lights separated by said first polarization separation section

coincide with respective polarization faces, to apply these linearly polarized lights to said variable polarization plane rotator;

a second polarization separation section that carries out polarization separation of light output from said variable polarization plane rotator to output the separated lights to any of a plurality of optical paths for which the travel directions are mutually different;

a plurality of polarization restoring sections that restores the polarization of light output by said second polarization separation section to each optical path to the polarization state before polarization separation by said first polarization separation section; and

a plurality of polarization combining sections that combines lights for which the polarization states have been restored by said polarization restoring section, to input the combined light to the output side optical paths corresponding to said each optical path,

wherein switching of said plurality of output side optical paths is performed by adjusting the rotation angle of the polarization plane, at said variable polarization plane rotator, of the linearly polarized light which has been separated by said first polarization separation section.

14. An optical switch according to claim 13,

wherein said second polarization separation section is a wedge polarization separation element.

15. An optical switch according to claim 14,

wherein said optical switch is provided a third polarization separation section comprising a wedge polarization separation element with the same shape and the same quality as said second polarization separation section, and

the directions of travel of lights output to respective optical paths from said second polarization separation section are made approximately parallel with each other by being transmitted through said third polarization separation section, and said approximately parallel respective lights are input to output side optical paths corresponding to said respective optical paths via said single polarization restoring section and said single polarization combining section.

16. An optical filter using a variable polarization plane rotator of claim 1, comprising:

a polarization separation element that carries out polarization separation of light output from an input side optical path to apply the separated lights to said variable polarization plane rotator; and

a polarization wavelength characteristic changing element that is input with a linearly polarized light output from said variable polarization plane rotator, and has a characteristic in that wavelength changes for transmission ratio or reflection ratio for two polarization components which intersect within a horizontal plane perpendicular to the travel direction of said linearly polarized light are different,

wherein the wavelength characteristics for transmission light or reflection light of said polarization wavelength characteristic changing element are made variable by adjusting an rotation angle of the polarization plane, at said variable polarization plane rotator, of the linearly polarized light which has been separated by said polarization separation element, to change a ratio of said two intersecting polarization components for the linearly polarized light input to said polarization wavelength characteristic changing element.

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